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Evaluating Professional Development through Mechatronics Engineering Internship: A Feedback-Based Analysis

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ABSTRACT

This paper evaluates the professional development of Mechatronics Engineering students (n=56) at the International Islamic University Malaysia (IIUM) through a feedback-based analysis of industrial training collected in Semester 3, 2023/2024. The study incorporates feedback from two perspectives: company supervisors and academic examiners, focusing on targeted Program Outcomes (PO): PO8 (ethics), PO9 (individual and teamwork), and PO10 (communication). Quantitative analysis revealed that company supervisors rated students highest for ethics (PO8, mean = 93.46%), followed by teamwork (PO9, mean = 90.75%), and communication (PO10, mean = 88.69%), with statistically significant differences between groups ($p < 0.001$). In contrast, marks assessed by IIUM lecturers showed similar averages across PO groups (PO8 = 87.74%, PO9 = 86.83%, PO10 = 86.46%) and no significant differences ($p = 0.495$). A paired samples t-test further demonstrated that company supervisors awarded significantly higher marks overall than academic lecturers (mean difference = 3.96, $t(167) = 4.104$, $p < 0.001$, Cohen's $d = 0.32$), with a weak correlation between the two assessor groups ($r = 0.334$, $p < 0.001$). Preliminary observations suggest that while students generally demonstrate strong ethical behaviors and teamwork, communication skills vary depending on the placement environment. The weak correlation indicates differing assessment perspectives, likely reflecting the contrast between practical, real-time evaluation and more standardized academic appraisal.

Keywords: Engineering students, Industrial training, Professional development, Program outcomes

1. INTRODUCTION

Industrial training in engineering offers students invaluable first-hand experience in professional environments outside the university. According to the Engineering Accreditation Council (EAC) Manual 2024 [1], these requirements can be met through either conventional industrial training or Work-Based Learning (WBL), with a minimum duration of eight weeks and a maximum of six student learning time (SLT) credits. Notably, this training must be completed before the student's final semester.

At IIUM, the Mechatronics Engineering program emphasizes the development of professional values articulated in its Program Outcomes (PO), particularly PO8 (ethics), PO9 (individual and teamwork), and PO10 (communication) [1]. To ensure students develop the skills needed for complex engineering tasks, the program requires exposure to a broad range of engineering processes at the practical level.

Internship performance is assessed through a holistic, multi-source evaluation process involving both academic lecturers and industrial supervisors [2,3]. This approach provides a comprehensive understanding of each student's development and readiness for professional practice. Work Integrated Learning (WIL) further strengthens this process by fostering

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collaboration between academic and industry supervisors, ensuring that students are thoroughly prepared for both their internships and subsequent employment [4,5]. Effective WIL strategies have been shown to enhance the partnership between universities and industry, benefiting student learning outcomes and professional development [6]. Collaborative supervision practices play an essential role in supporting students during their placements and promoting effective knowledge exchange between stakeholders [7].

University plays a vital role in preparing and monitoring students throughout their internships [3]. Clear communication of roles and responsibilities to both students and industry supervisors is essential, as is the provision of constructive feedback to support student growth. In addition to technical skills, internships are crucial for developing soft skills [8, 9], especially communication abilities, which are essential for professional success [10]. Evaluations from both employers and students underline the importance of these skills and highlight how cooperative education programs can positively influence graduate readiness across diverse engineering disciplines [7]. Furthermore, integrating work experiences through reflective learning practices significantly enhances students' skill development and professional preparedness [11]. The supervisory roles of university staff include providing support, bridging theory and practice, facilitating collaboration, conducting evaluations, and managing the internship play a critical role in the success of the internship and in students' overall development. [12].

The integration of evaluations from both industry supervisors and academic examiners is a notable strength of the internship program. This study explores how effectively the internship experience supports the development of the targeted learning outcomes, using feedback from company supervisors and academic examiners in the Department of Mechatronics Engineering, IIUM.

2. METHODOLOGY

2.1 Data Collection

A total of 56 internship students from the Department of Mechatronics Engineering, IIUM, who underwent a 12-week internship, were involved in the assessment. Feedback and evaluation data were collected from two primary sources industry supervisors, who evaluated the students' performance during their internship placements, and academic examiners, who assessed the quality of the students' logbooks, reports, and oral presentations.

Industry supervisors assessed the students' performance at the end of the internship period, while academic examiners evaluated the students' presentations during mid-internship period and reviewed the logbook and the final reports upon completion of the internship. Each academic examiner was responsible for evaluating three to four students.

2.1.1 Industry Supervisors Assessment

The supervisor assessment utilizes a rubric comprising ten questions, each aligned with one of three key Program Outcomes (POs): PO8 (Ethics), PO9 (Individual and Teamwork), and PO10 (Communication) to systematically evaluate the core professional competencies emphasized in the Mechatronics Engineering program. Each question is rated by supervisors on a 4-point Likert scale (1–4), corresponding to unacceptable, marginal, acceptable, and exemplary, with all items weighted equally in the overall assessment. Table 1 groups the questions according to their respective POs, enabling a focused analysis of student strengths and areas for improvement in ethics (PO8), teamwork (PO9), and communication (PO10). This structured approach ensures that the evaluation is both comprehensive and corresponds to the intended learning outcomes of the internship experience.

Table 1 Mapping of supervisor assessment questions to program outcomes (PO8: ethics, PO9: individual and teamwork, PO10: communication)

Program Outcome (PO)	Assessment Item (Weight)	Total weight
PO8 (Ethics)	Integrity and moral values (1)	3
	Commitment to obligations (1)	
	Collaborative Integrity (1)	
PO9 (Individual and Teamwork)	Attendance and punctuality (1)	4
	Teamwork and collaboration (1)	
	Proactive initiative and independence (1)	
	Performance quality (1)	
PO10 (Communication)	Ability to carry out the task/project on time (1)	3
	Proactive in seeking knowledge (1)	
	Professionalism in soft skills (communication, writing, and presentation) (1)	

2.1.2 Academic Examiners Assessment

The academic examiners evaluated each intern by assessing both the logbook and the final internship report, using structured rubrics to measure student performance across the targeted program outcomes. Table 2 provides a structured overview of how students' internship performance is evaluated in relation to the targeted Program Outcomes (POs): Ethics (PO8), Individual and Teamwork (PO9), and Communication (PO10). Each assessment item from both the logbook and the internship report is mapped to its relevant PO and assigned a specific weight to reflect its importance in the overall evaluation. Each question is rated by lecturers on a 4-point Likert scale (1–4), corresponding to unacceptable, marginal, acceptable, and exemplary. This comprehensive grouping ensures that both day-to-day activities (logbook) and reflective, analytical skills (report) are fairly represented in measuring students' achievements across all key professional domains. In Table 2, 'Lx' refers to Logbook questions, where 'L' denotes Logbook and 'x' indicates the question number. Similarly, 'Rx' refers to Report questions, with 'R' representing Report and 'x' indicating the corresponding question number.

The total weights for PO8 and PO9 are the same for both academic examiners and industry supervisors. However, the weight for PO10 differs, with academic examiners assigning a total of 10 compared to only 3 by industry supervisors. This difference reflects the focus of academic examiners on written components such as the logbook and report, while industry supervisors evaluate students' overall communication performance throughout the internship.

Table 2 Mapping of academic examiners assessment items to program outcomes (PO8: Ethics, PO9: Individual and Teamwork, PO10: Communication)

Program Outcome (PO)	Logbook Items (Weight)	Report Items (Weight)	Total Weight
PO8 (Ethics)	-	R1: Ethical issues and dilemmas (2)	3
		R2: Integrity and professional responsibility (1)	
PO9 (Individual and Teamwork)	L4: Supervisor's approval and feedback (1)	R3: Teamwork experiences (2)	4
		R4: Collaboration with colleagues (1)	
PO10 (Communication)	L1: Task/Project description (2)	R5: Clarity and organization (2)	10
	L2: Understanding on the task (1)	R6: Technical explanation/data (2)	
	L3: Timeliness of entries (1)	R7: Visual aids (1)	
		R8: Structure/language (1)	

2.2 Statistical Analysis

2.2.1 Statistical Analysis of Program Outcome Performance

Quantitative data (student marks) from both industry supervisors and academic examiners were analyzed using SPSS statistical software to compare student performance across the targeted program outcomes. The primary focus was to compare student performance across the three targeted POs using one-way ANOVA, followed by post hoc tests to identify significant differences among the PO groups. Separate analyses were conducted for marks given by industry supervisors and academic examiners.

2.2.2 Comparison of Supervisor and Academic Examiner Assessments

To evaluate the consistency between industry supervisors and academic examiners in assessing student performance, a paired samples t-test was conducted using combined marks for each student across PO8 (ethics), PO9 (individual and teamwork), and PO10 (communication), resulting in 168 paired observations (56 students × 3 POs).

3. RESULTS

3.1 Program Outcome Performance

The industry supervisor assessments revealed notable differences in how students performed across the three targeted program outcomes. Descriptive statistics showed that students received the highest mean score for ethics (PO8: 93.46%), followed by individual and teamwork (PO9: 90.75%), and communication (PO10: 88.69%). Analysis of variance (ANOVA) revealed a statistically significant difference in marks among the PO groups ($F(2,167) = 12.210$, $p < 0.001$). Post hoc Tukey tests further indicated that students scored significantly higher in PO8 than in both PO9 and PO10, with PO9 also rated higher than PO10, as shown in Figure 1.

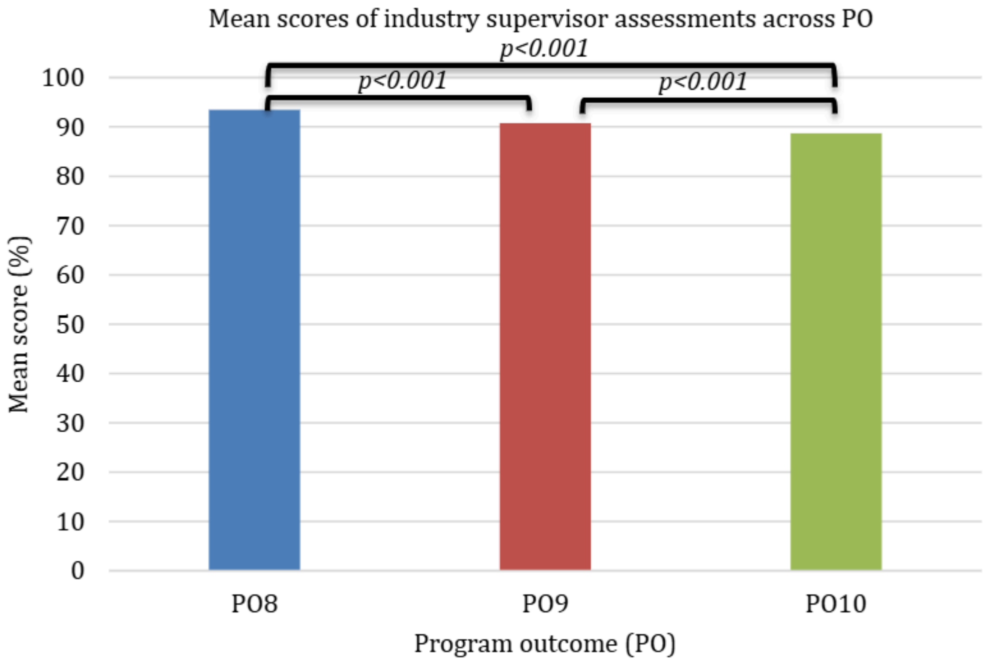

Figure 1. Mean scores of industry supervisor assessments of student performance across targeted PO.

In contrast, the academic examiner assessments showed less variation in student performance across the same program outcomes. The mean scores for ethics (PO8), individual and teamwork (PO9), and communication (PO10) were 87.74%, 86.83%, and 86.46%, respectively as shown in Figure 2. ANOVA results showed no statistically significant differences among the PO groups ($F(2,167) = 0.708$, $p = 0.495$), and post hoc analysis similarly revealed no significant differences between the groups.

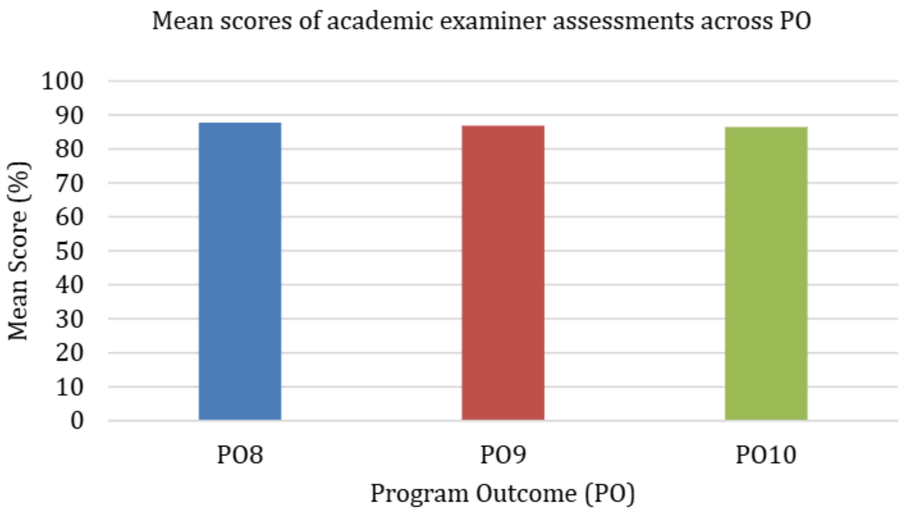

Figure 2. Mean scores of academic examiner assessments of student performance across targeted PO.

The summary of the results is shown in Table 3:

Table 3 Summary of assessment results by company supervisor and academic examiner across program outcomes (PO)

Assessor	PO8 Ethics (%)	PO9 Teamwork (%)	PO10 Communication (%)	Significant Difference?
Company Supervisor	93.46	90.75	88.69	Yes (PO8 > PO9 > PO10)
Academic Examiner	87.74	86.83	86.46	No

3.2 Comparison of Supervisor and Academic Examiner Assessments

Table 4 presents the finding that the company supervisors assigned significantly higher scores (90.97 ± 11.13 %) compared to academic examiners (87.01 ± 10.53%), resulting in a mean difference of 3.96% (SD = 12.51). This difference was statistically significant, $t(167) = 4.104$, $p < .001$, with a small-to-medium effect size (Cohen's d = 0.32, 95% CI [0.16, 0.47]). The correlation between supervisor and academic examiner marks was weak ($r = .334$, $p < .001$), indicating limited agreement in scoring between the two assessor groups.

Table 4 Paired T-Test Results: Comparison of Marks from Company Supervisors and Academic Examiners

Assessor Pair	Mean Difference	t	p	Cohen's d	Correlation (r)
Supervisor vs. Academic Examiners	3.96	4.104	< .001	0.32	.334

4. DISCUSSION

The findings reveal a clear contrast between workplace and academic perspectives on student performance. Company supervisors differentiated strongly among the program outcomes, rating students highest in ethics, followed by teamwork, and lowest in communication. In contrast, academic examiners showed relatively uniform scores across outcomes, suggesting a more holistic or standardized approach to evaluation.

This difference likely stems from the nature of interactions in each setting. Supervisors observe interns in real workplace situations, including task performance, teamwork, and ethical conduct, allowing them to assess applied competence. Students may therefore appear to perform better in practical contexts than in structured academic assessments. Supervisors also tend to prioritize attributes that are immediately valuable in industry such as reliability, responsiveness, and professionalism which can lead to higher scores in soft-skill–related POs. Moreover, the working relationship built over the internship and the supervisory role as both evaluator and mentor may contribute to more favourable assessments. The stronger ratings for ethics and teamwork from supervisors suggest that IIUM students are well-prepared for professional conduct and collaboration in the workplace but may require additional support to strengthen their communication skills, especially in diverse industrial environments.

The observed difference in marks and weak correlation between supervisors and academic examiners assessments can be attributed to differing contexts and criteria of evaluation. Supervisors' marks reflect continuous workplace engagement, while academic examiners' scores are based on both logbooks and final reports, potentially emphasizing communication and analytical skills. Academic examiners often apply more standardized and rigorous criteria, reflecting institutional expectations for consistency in grading. Their evaluations may focus more on evidence-based justification and documentation, which can lead to comparatively lower scores. This aligns with the moderate positive correlation ($r = .334$), indicating that while both assessors evaluate similar constructs, they do so with different degrees of strictness. This highlights the importance of multi-source assessment for a comprehensive evaluation of student professional development. Previous research confirms that such a holistic approach captures the complexity of internship outcomes and supports continuous improvement in engineering education [6-7, 12].

To enhance the effectiveness of the internship program, several improvements are recommended. Communication training should be strengthened by integrating targeted workshops both before and during the internship to help students convey technical ideas clearly and professionally [3]. Maintaining a multi-source assessment approach combining evaluations from both industry supervisors and academic examiners will ensure a more balanced and comprehensive assessment of student performance [2,4].

However, this paper has several limitations. The study involved a single cohort of Semester 3, 2023/2024 students, representing a relatively small sample size. The short internship duration may also limit opportunities for deeper professional development [7]. Additionally, presentation marks from academic assessors were not included in the analysis. This omission is unlikely to affect the findings, as presentation assessments evaluate communication skills already captured through written components and contribute only a small portion to the overall score. Since the study focused on comparing trends between academic and industry assessments, the observed patterns remain valid. Future research may include presentation marks to provide a more complete academic assessment profile.

5. CONCLUSION

Feedback-based analysis demonstrates that the IIUM Mechatronics Engineering internship program effectively supports the development of key professional values, especially ethics and teamwork. However, communication skills may require further emphasis, particularly in the industrial context. The difference in perspectives between company supervisors and academic examiners suggests the value of multi-source feedback in evaluating student development. To better align with EAC 2024 requirements, the program could incorporate targeted communication training, such as pre-internship industry communication workshops, clearer assessment rubrics, and reflective communication tasks. Continuous program evaluation incorporating multi-source feedback and reflective learning is essential to address identified gaps, particularly in communication skills, thereby ensuring the internship remains aligned with evolving industry expectations and effectively prepares students for professional practice.

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